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Research Product 86-27

**Defining Roles in the Development of a
Computer-Aided ARTEP
Production System (CAPS)**

**ARI Field Unit at Presidio of Monterey, California
Training Research Laboratory**

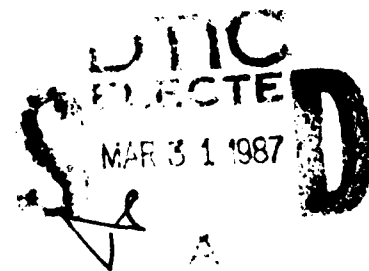
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The U.S. Army Training Board (ATB), the U.S. Army Infantry School (USAIS), the U.S. Army Armor School (USAARMS), the U.S. Army Intelligence Center and School (USAICS), the Army Training Support Center-Information Management Office (ATSC-IMO), and the U.S. Army Research Institute (ARI) are involved in developing a Computer-aided ARTEP Production System (CAPS). The CAPS concept calls for the application of a commercially available Relational Database Management System (RDBMS) to ARTEP development. This report provides an updated version of the CAPS design concept, and it defines the roles of CAPS participants in the near-term development of a working CAPS within USAIS.

Keywords: FMTP (ARTEP Mission Training Plan).

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**Defining Roles in the Development of a
Computer-Aided ARTEP
Production System (CAPS)**

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FOREWORD

The Presidio of Monterey Field Unit of the Army Research Institute (ARI) is concerned with improving unit collective training through research and development. One aspect of this work concerns the design and preparation of Army Training and Evaluation Program (ARTEP) documents by Army service schools as guides to unit collective training. Research in this area is conducted by the Collective Training Design Team under the sponsorship of the proponent for ARTEP development policy and procedures, the U.S. Army Training Board (ATB).

ARI and ATB are developing a Computer-aided ARTEP Production System (CAPS) in cooperation with the U.S. Army Infantry School (USAIS), the U.S. Army Armor School (USAARMS), the U.S. Army Intelligence Center and School (USAICS), and the Army Training Support Center-Information Management Office (ATSC-IMO). This report provides an updated version of the CAPS design concept, and it defines the roles of CAPS project participants in the upcoming development of a working CAPS within USAIS.



EDGAR M. JOHNSON
Technical Director

DEFINING ROLES IN THE DEVELOPMENT OF A COMPUTER-AIDED ARTEP PRODUCTION SYSTEM (CAPS)

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DEFINING ROLES IN THE DEVELOPMENT OF A COMPUTER-AIDED ARTEP PRODUCTION SYSTEM (CAPS)

Introduction

A. The Growing Need to Automate ARTEP Production

U.S. Army branch service schools are responsible for preparing ARTEP documents as guides to unit training. The preparation of an ARTEP is a lengthy, complex task. Drafting an ARTEP requires searching for appropriate reference in tactical doctrine, analyzing mission/task performance requirements, and writing/editing voluminous amounts of material (i.e., the resulting product may, in certain cases, exceed one thousand pages).

The workload associated with the preparation of ARTEPs is substantial in terms of the number of ARTEPs to be prepared by each school and in terms of the amount of work required to prepare each ARTEP. Current efforts to modernize the force have increased the number of ARTEPs produced within certain schools, while efforts to improve ARTEPs have had the effect of increasing the work required to prepare each ARTEP.

The number of ARTEPs to be produced by a school depends on the number of unit types for which that school is responsible for preparing ARTEPs, and it depends on the frequency with which each ARTEP must be revised. Ongoing efforts to modernize the force often result in new types of units for which schools must assume responsibility. Further, force modernization through the adoption of advanced weapons, vehicles and equipment often results in changes in the tactical doctrine for existing units, and these changes in doctrine necessitate revisions of ARTEPs.

The workload associated with the preparation of each ARTEP is growing in an effort to more effectively meet the information needs of ARTEP users. In the past, ARTEPs provided users with potential training requirements by describing unit missions and subordinate collective tasks. These descriptions were developed through the process of Front-End Analysis (FEA). The new generation of improved ARTEPs provides descriptive unit training plans called ARTEP Mission Training Plans (AMTPs) and Drills. These improvements shift certain complex analyses required to develop unit training plans from the shoulder of the ARTEP user to that of the ARTEP developer. That is, ARTEP developers must carefully analyze training-relevant features of specific collective tasks and use the results of these analyses to develop descriptive unit training plans. Figure 1. illustrates the growth of the ARTEP development process as a function of ARTEP improvement.

The preparation and revision of ARTEP products is presently accomplished by use of typewriters and stand-alone word processors. The ARTEP development audit trail linking tactical doctrine (e.g., "How to Fight" manuals) to FEA to ARTEP documents is represented by a lengthy, complex paper trail. Thus there is a considerable time lag between the point when the need to prepare/revise an ARTEP is recognized and the point when a finished product is made available. Automating the ARTEP development process will help schools to be more responsive to the needs of ARTEP users.

New Steps in ARTEP Development

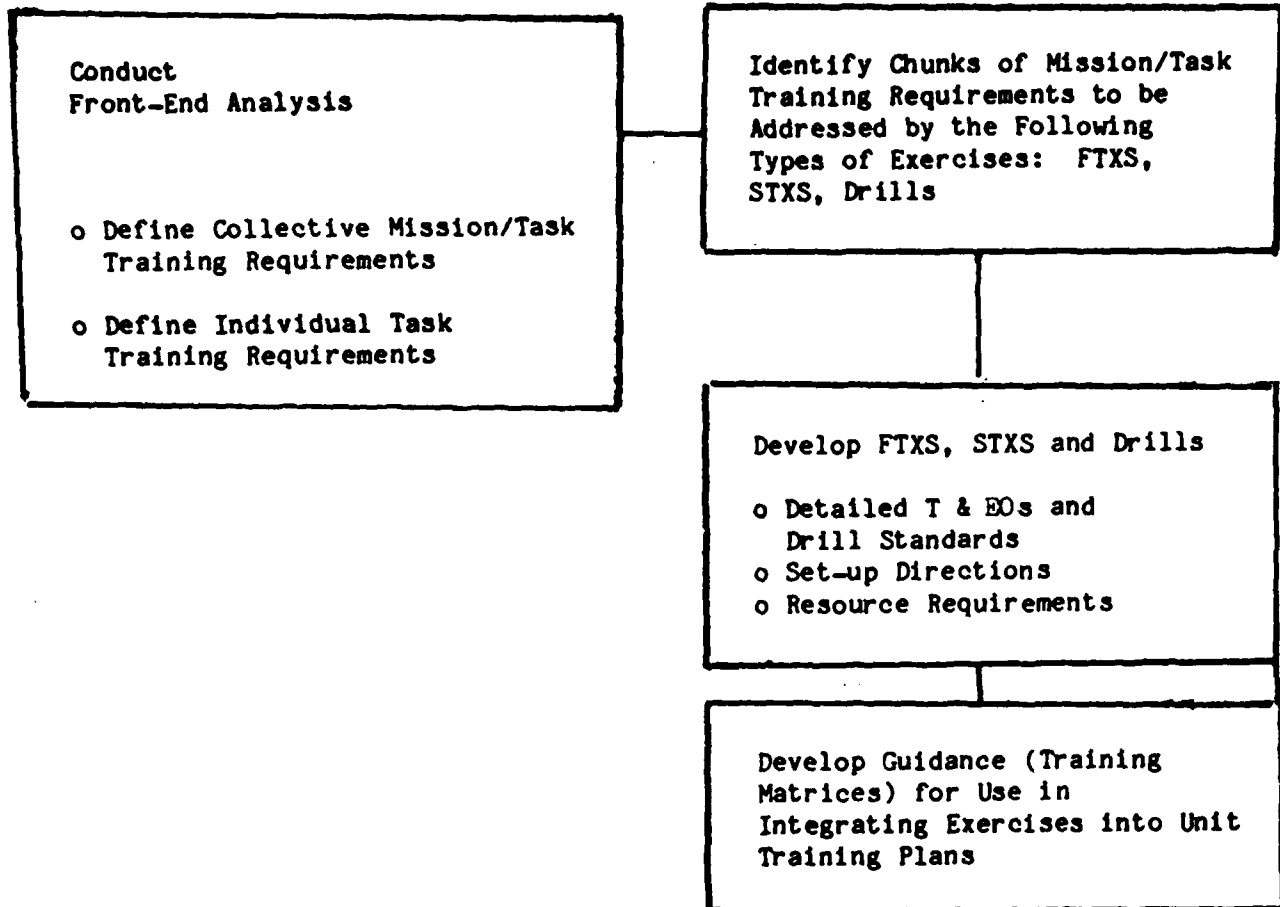


Figure 1. Growth of the ARTEP Development Process as a Function of the ARTEP Improvement Effort.

B. The Importance of Standardized Yet Flexible Application of Computer Technology to ARTEP Development

Haphazard automation is potentially a serious problem resulting in wasteful duplication of effort and/or inadequate attempts to automate functions. Army Regulation 18-1, Army Automation Management, was developed to guide the application of automation to Army needs.* Compliance with AR 18-1 imposes the requirement to consider the functions and hardware/software specifications of other automated systems with which the system under development might need to interface. In the case of ARTEP development, there are already a number of related automated systems under development which need to be considered (see Table 1.). Attaining compatibility with these systems will ensure effective transmission of information among schools and integrating centers, and it will provide valuable information about how ARTEP products are used by operational units.

For two reasons, it is also critical that automation be applied to ARTEP development in a flexible fashion. First, the ARTEP development process differs among the various schools. Second, the ARTEP document was intended to be evolutionary in nature, and it has proven to be evolutionary in nature. Effective application of computer technology to ARTEP development requires a standardized system concept which can accommodate differences among schools and continued evolution of the ARTEP document.

C. The Computer-aided ARTEP Production System (CAPS) Project

The U.S. Army is preparing to apply computer technology to the job of preparation of ARTEP documents through the development of a Computer-Aided ARTEP Production System (CAPS). Participants in this effort include the U.S. Army Training Board (ATB), the U.S. Army Infantry School (USAIS), the U.S. Army Armor School (USAARMS), the U.S. Army Intelligence Center and School (USAICS), the U.S. Army Training Support Center-Information Management Office (ATSC-IMO) and the U.S. Army Research Institute (ARI).

The CAPS project is divided into three phases. Phase I is now complete. It involved defining the CAPS concept to an extent which provided valid estimates of CAPS hardware and software requirements.** In brief, the CAPS design concept calls for applying commercially available software known as a Relational Database Management System (RDBMS) to the ARTEP development process. Such a system is expected to be flexible enough to accommodate differences among schools, because each school would have control over the information to be placed in the database, as well as having control over how this information is applied. Standardization over the application of computer technology to ARTEP development is gained by reducing the hardware and RDBMS options to those compatible with related systems under development within the Army.

* AR 18-1 will be replaced by AR 25-5, however, the automation concerns described in this report are not influenced by this replacement.

** Bloedorn, Crooks, Merrill, Saal, Meliza and Kahn. Concept Study of the Computer-aided ARTEP Production System (CAPS). ARI Research Report 1403, July, 1985.

Table 1.

Selected Systems with Which CAPS Must Interface

TRADOC COMMAND MANAGEMENT INFORMATION SYSTEM (TCMIS) Controls exchange of information among TRADOC schools/agencies. Subsumes a wide range of automated systems (including CAPS).

DEFENSE DATA NETWORK (DDN) Transmits data between/among TRADOC installations.

ARMY INTEGRATED PUBLISHING AND PRINTING SERVICE (AIPPS) Responsible for mass printing of test and final ARTEP products.

INTEGRATED TRAINING MANAGEMENT SYSTEM (ITMS) Unit automated training management system.

The second phase of the CAPS project involves developing a working CAPS within USAIS. During this phase, the working CAPS will pass through the entire Army Automation Life Cycle, summarized in Table 2. Information gained from the development of the working CAPS will carry the TRADOC-wide CAPS from the "Mission Analysis Project Initiation" phase through the "Concept Development" phase of the life cycle. In addition, information gained through carefully defined reviews of the working CAPS by USAARMS and USAICS should carry the TRADOC-wide CAPS through the "Definition and Design," and "System Development" phases, and hasten TRADOC-wide implementation within the "Development and Operations" phase.

Phase III involves refining CAPS during and after TRADOC-wide implementation. Many refinements will, in fact, be made by particular schools to ensure that the CAPS effectively meets their specific needs. Other refinements will be made to take advantage of (1) the wealth of information available from related automated systems and (2) improvements in hardware and software.

The project management information developed by the CAPS Project will be used by the ATSC Information Management Office (IMO), the Project Manager for the TRADOC Command Management Information System (TCMIS) Training Module. As presently conceived, CAPS will be an integral part of the TCMIS Training Module and utilize TCMIS hardware.

D. Purpose and Format of Document

User involvement in the development of a product, such as a CAPS, helps to ensure the product will be successfully implemented. In cases where the product to be developed is an automated system, it is also important to coordinate with developers of related automated systems. However, an increase in the number of organizations involved in product development can delay or even abort product development. The solution to this apparent dilemma is to carefully define roles of participating organizations as early as possible.

The purpose of this document is to help prepare project participants for their upcoming roles in the development of a working CAPS within USAIS and to provide an updated version of the CAPS design concept which reflects (1) reductions in CAPS hardware/software options to support compatibility with other automated systems, (2) modifications of hardware/software options to take advantage of recent advances in computer technology, and (3) recent work on refining the ARTEP development process to be assisted by automation.

Table 2.

Overview of the Army Automation Life Cycle

<u>Phase</u>	<u>Description</u>
Mission Analysis/Project Initiation	Describe the Army mission functions to which automation may be applied.
Concept Development	Analyze and evaluate alternative methods to accomplish functions identified in previous phases.
Definition and Design	<u>Fully</u> define functional requirements and design operable automated system.
System Development	Implement and test automated system.
Deployment and Operation	Install and operate system at all approved locations. Improve and refine system if necessary and feasible.

The CAPS Design Concept

A. CAPS Hardware

Figure 2. illustrates the major hardware components of the CAPS concept. Each of these components is discussed below in brief detail.

1. Central Minicomputer

The central minicomputer will contain that part of the ARTEP development database which needs to be tightly controlled because its contents are shared among the various organizations involved in ARTEP development. This database includes "finished products" of the work of doctrine developers, task analysts and ARTEP writers. The contents of the database are shared in that the products of the work of one individual/group serve as input for the work of other individuals/groups.

A wide range of minicomputers has the potential to meet the memory requirements specified in the concept study. To ensure compatibility with the TCMIS, Training Module it was decided that the options for the CAPS minicomputer should be reduced to VAX 11/750 "look alikes". Most Army schools are already familiar with the VAX 11/750 because it is the Army Instructional Management System (AIMS) computer.

To effectively serve multiple ARTEP development functions and to store the large number of documents involved in the ARTEP development process, the CAPS concept requires expanding the random access memory (RAM) of the basic VAX 11/750 by sixfold. The RAM of the CAPS is thus much greater than that of the initial AIMS (i.e., the AIMS is scheduled for a near-term upgrading of RAM). The large RAM of the CAPS VAX 11/750, combined with the use of "smart" work stations capable of performing information processing activities, should help to avoid the long delays sometimes encountered when a system has multiple users.

2. Work Station

Personal computers (PCs) linked to the central minicomputer will directly support the work of individual task analysts and ARTEP writers. The PC database will contain (1) copies of finished products serving as input to a particular job, (2) working notes, and (3) draft products. The use of PCs, as opposed to "dumb terminals" will shift much of the processing load from the minicomputer to work stations.

The PC to be used for CAPS "smart" work stations must meet the requirements described below.

- o The PC must be able to communicate with the VAX 11/750 to allow transfer of files between the work station and the central minicomputer. Quite simply, a PC and a minicomputer like the VAX 11/750 transmit/receive data in ways which are incompatible. Therefore, a hardware/software solution must have been developed which allows the PC selected to emulate a "dumb" terminal for the VAX 11/750.

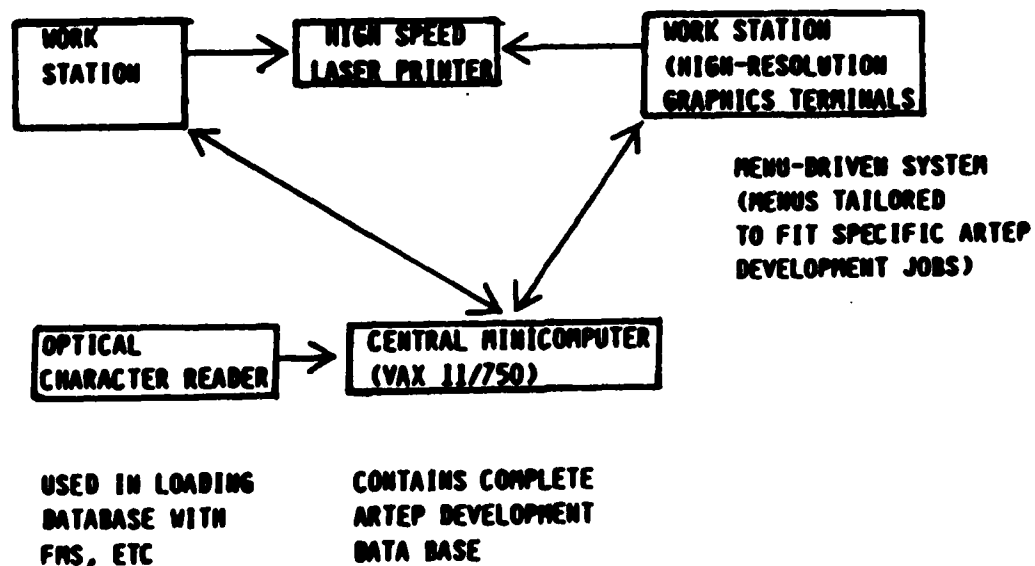


Figure 2. Major Hardware Components of a CAPS

- o High resolution graphics monitors must be available for use with the selected PC. This requirement is due to the fact that approximately 50 percent of the content of AMTP/Drill documents is in the form of figures and tables.
- o Software necessary for the PC to support graphics, word processing and analytical functions must be available.

A wide range of PCs appears to meet the above specifications. However, the ideal PC would be the one selected to replace the "dumb" terminal currently employed by the AIMS (i.e., as part of the TCMIS-Training Module). Unfortunately, this PC requires a software solution to allow full communication between the PC and the minicomputer. While the necessary solution is under development, and the solution will undoubtedly be available prior to TRADOC-wide implementation of CAPS, the solution may not be available in time to allow this PC to be used for the working CAPS at USAIS. At any rate, the PC for the working CAPS will be selected in a way which ensures that the results of this effort can be ported to TCMIS-Training Module hardware and software. Selection of the PCs will be delayed until the functional requirements for a CAPS are finalized/updated during the first task involved in developing a working CAPS.

3. High-speed Laser Printers

Quality printing of graphics requires the use of high-speed laser printers. Such printers also offer the benefit of a quick turn around time when draft ARTEP products are prepared for staffing. The cost of these printers vary considerably. Laser printers meeting high durability specifications (in terms of printing loads) cost much more (i.e., as much as twenty times more) than newer printers meeting moderate specifications. It must also be considered that the CAPS printers will not be used in mass producing ARTEP products for Army-wide distributing, because such heavy printing loads are a function of the Army Integrated Printing and Publication System. Therefore, given the comparatively small printing load expected for CAPS, printers meeting moderate durability specifications appear to be adequate.

4. Optical Character Reader

The concept study for a CAPS prototype also produced an initial plan for effecting the transition to automated ARTEP production. A key element of this transition is the transfer of all the documents pertinent to ARTEP production to the CAPS database. A powerful tool suggested for use in accomplishing this task is the Optical Character Reader (OCR). An OCR removes the need to type thousands of pages of material into the CAPS.

B. Relational Database Management System

The CAPS concept calls for using the INGRES Relational Database Management System (RDBMS) to support ARTEP development, rather than developing new software. That is, commercially available software which has already been successfully applied to help automate a number of jobs will be applied to ARTEP development.

The INGRES was selected over other relational database management systems to, in part, ensure compatibility between CAPS and the TCMIS-Training Module. Brief descriptions of a RDBMS and potential applications of a RDBMS to ARTEP development are provided below. Finally, a brief "walk-through" of the use of a RDBMS in preparing AMTP/Drill documents is provided.

1. Description of a RDBMS

Conceptually, a RDBMS stores information in a tabular format. A RDBMS is "user-friendly" because one-line commands can be used to (a) load information into tables (b) revise/update information and (c) reorganize information within and across tables to meet information needs of database users.

Figure 3. illustrates portions of two hypothetical RDBMS tables. Each table has a name and is organized so that column 2 and beyond provide information about the people, objects or events listed in column 1. For example, the table called "education" contains information about the personnel listed in column 1 (e.g., rank, highest degree received, undergraduate and graduate schools attended). A file containing such information on thousands of individuals might be inserted into a RDBMS table using a single one-line command.

Certain benefits gained by having information in a tabular format can be illustrated by again using Figure 3. First, a one-line command might be used to provide a list of individuals meeting either a specific criterium (e.g., having an MS degree) or combination of criteria (i.e., having an MS degree from Yale). Second, the RDBMS can be used to answer questions which involve analyzing information in more than one table. For example, the table "college" in Figure 3. contains information about specific colleges (i.e., whether the schools has a ROTC program, approximate number of students). The information within the "education" and "college" tables can be selected out and reorganized, in response to a one-line command, to provide a list of the personnel which have received degrees from schools having ROTC programs.

The application of a RDBMS to particular jobs involves deciding what information is to be stored in the database, and it involves deciding how to organize this information into tables. The manner in which information is arranged into tables is important, in part, to ensure that analyses can be performed across tables where necessary.

2. Potential Application of a RDBMS to ARTEP Development

A greater appreciation of the application of a RDBMS to ARTEP development can be gained by considering the types of information which might be contained in a CAPS database. Figure 4. illustrates a portion of a CAPS-relevant table which provides two types of information about collective tasks (i.e., the references from tactical doctrine which support each task and the name of the STXs in which each task is embedded). The utility of the table to ARTEP developers can be illustrated by considering that a one-line command could be used to provide a list of all of the collective tasks and STXs supported by a specific reference from tactical doctrine.

The specific information to be included in a CAPS database, as well as the manner in which this information will be organized into tables, will be

TABLE NAME: EDUCATION

NAME	RANK	HDEGREE	UCOLL	GCOLL	AROTC
SMITH, JAMES L	1LT	M.A.	SPU	U. TEXAS	YES
SMITH, JOHN H	LTC	M.S.	IOWA	IOWA ST	NO

TABLE NAME: COLLEGE

UCOLLEGE	ROTC PROG	STUDENTS
ALABAMA	YES	30,000
AUBURN	YES	20,000

Figure 3. Portions of sample RDBMS Data Tables

TABLE NAME: COLTASK		
CT NAME	FM REFS	STX
MOVE IN BOUNDING OVERWATCH	FM7-10 PG 36 PAR 3, FM7-20 PG 63, PAR 2	MOVE TO CONTACT
MAINTAIN SECURITY	FM-10 PG 6 PAR 1, FM-20 PG 8, PAR 2	OCCUPY ASSEMBLY AREA

The diagram shows a line starting at point BA, rising to a peak, then falling to point FI, and finally rising again. Three arrows point upwards from below the line to the table columns: the first arrow points to the 'CT NAME' column, the second arrow points to the 'FM REFS' column, and the third arrow points to the 'STX' column.

TITLES OF
COLLECTIVE TASKS

FM REFERENCE
FOR EACH TASK

STX(S) IN WHICH
EACH TASK IS EMBEDDED

Figure 4. Portion of a sample RDBMS Data Table directly relevant to ARTEP development

determined in the course of developing a CAPS within USAIS. In addition, it must be considered that a particular school would have the flexibility to include additional types of information within a CAPS database.

C. CAPS "Walk-Through"

The description of CAPS hardware components and RDBMS features, provided above, set the stage for a "walk-through" of the application of a CAPS to the development and revision of AMTP/Drill documents. This walk-through will be conducted using Figure 5. as an aid. This figure indicates the major components of the database and the sequence in which the components are loaded into the database. A portion of these components will be handed-off to schools, and the remainder will be developed by schools during the AMTP/Drill development process.

The component to be handed-off to schools contains the POI for using the CAPS to develop AMTP/Drill documents. This POI defines the decisions to be made and products to be produced within each step of the AMTP/Drill development process, provides decision aids (rules of thumb and examples of the application of these rules) to support each of the judgments to be made during the process, tells the user how to reorganize the information within the database to meet specific information needs (standardized one-line commands), and provides instructions for loading existing and newly developed information and products into the database.

The first component of the database to be loaded at a particular school will be a description of the AMTP/Drill development workflow within that school. This component serves at least two major functions. First, it makes it possible to link specific duty positions to the appropriate portion of the POI. Second, it identifies the "owners" of the tables to be produced during the AMTP/Drill development process who have authority to add to or modify these tables (e.g., who has the authority to control the contents of the tables containing tactical doctrine).

The next component of the database to be loaded will be the source materials used in conducting a FEA (e.g., "How to Fight" Manuals, Battlefield Development Plans). The loading of these materials will be accomplished with the aid of an OCR to avoid excessive typing requirements.

Once the system has been loaded with the three database components described above, it should be set to guide users in conducting a FEA. The user will be instructed in using the RDBMS to rapidly reorganize the contents of FEA source materials to facilitate the analysis of these materials. For example, the system might assist the user in identifying the tactical references appropriate to a specific collective task by locating all doctrinal references (FM, page and paragraph numbers) containing a key word or phrase (e.g., overwatch position, surveil' nce). The user might then call up the text of these references on his/her terminal to determine the true applicability of each potential reference to the collective task. The products of the FEA will be loaded into the database, and they are likely to include the following: the name of potential mission and collective task training requirements; a description of what a unit should do/accomplish in performing each mission/task; resource requirements for performing each task; doctrinal references for mission tasks. Note that in performing a FEA, part

COMPONENTS LOADED TO SUPPORT TRANSITION

COMPONENTS LOADED AS ARTEPS ARE PRODUCED WITHIN THE SYSTEM

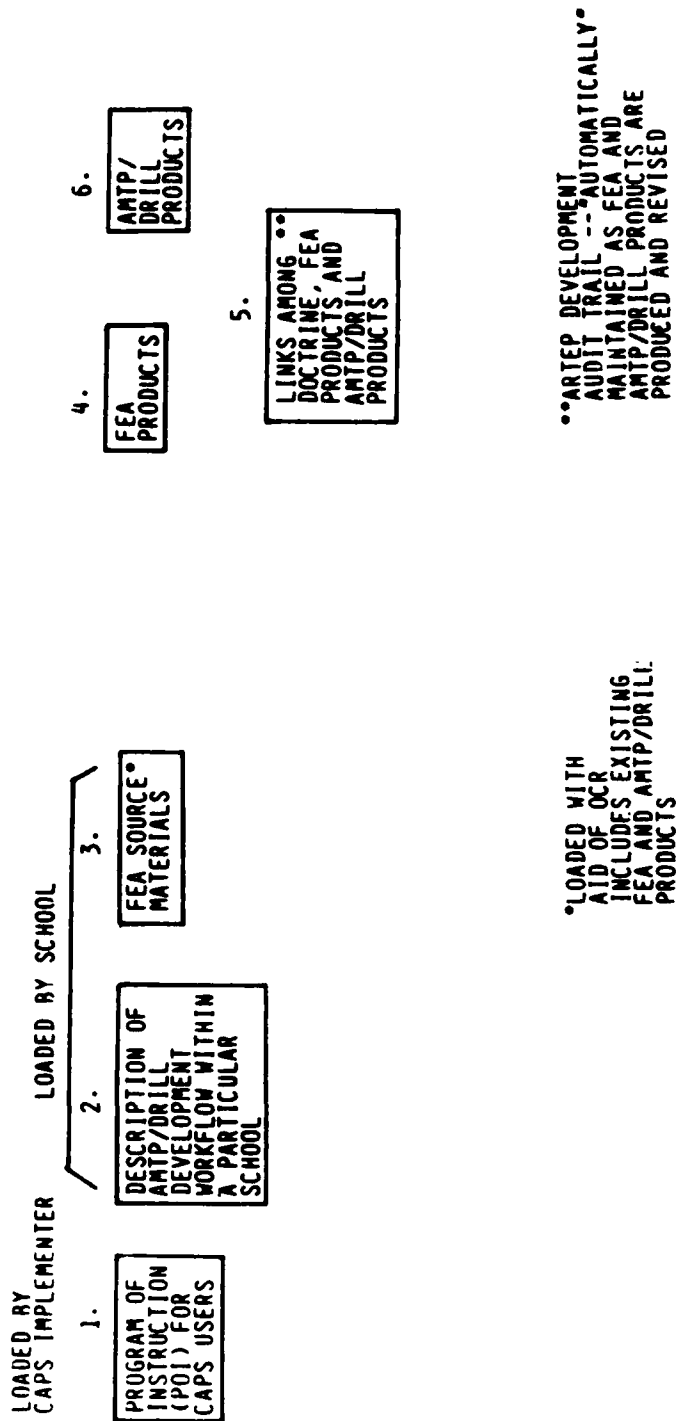


Figure 5. Major components of a CAPS database and transition to automated ARTEP production

of the fifth component of the database will also be produced (the template linking tactical doctrine to specific missions/tasks).

After a traditionally established FEA has been conducted, the CAPS should guide users in the selection of slices of battle to be addressed by Drills, STXs and FTXs. The process of selecting Drills and STXs is an especially critical and complex stage of the AMTP/Drill development process requiring complex judgments. Therefore, the POI portion of the database is likely to provide considerable decision aids to support this phase of ARTEP development. In addition, the POI should provide instructions for analyzing the FEA and tactical doctrine portions of the database to provide information which facilitates this phase. For example, an important part of the selection process for both Drills and STXs is the comparison of training requirements across collective tasks to identify duplications in subtasks, tasks or sequences of tasks. Information about collective tasks, recorded during FEA, should help CAPS users to identify groups of collective tasks which warrant comparison with each other (e.g., tasks likely to have overlapping training requirements would tend to: be supported by the same doctrinal references, serve the same unit functions, and have similar task steps).

In the course of selecting Drills/STXs/FTXs, the CAPS user will complete the loading of the fifth component of the database by linking training exercises to each other (e.g., identifying drill prerequisites for specific STXs) and linking exercises to specific missions and tasks. In effect, the fifth component of the database should serve to organize the AMTP/Drill audit trail to support subsequent revisions in AMTP/Drill documents. For example, the fifth component should make it possible to rapidly identify all FEA products, training exercises and training matrices requiring revision as a result of a change in tactical doctrine.

The sixth and final component of the CAPS database is loaded during the preparation of AMTP/Drill documents. Once again, the embedded POI should assist the user in analyzing information within the database to develop Drills, STXs and training matrices. In fact, the contents of the training matrices should already be embedded in the fifth component and need only be extracted in the required format.

Tasks in the Development of a Working CAPS Prototype/Roles of Participants

The effort described in this chapter includes the design, implementation and testing of a working CAPS within USAIS, and it includes assessment of the applicability of the prototype design features to schools other than USAIS. Eight major tasks are addressed during the development of a CAPS within USAIS. Most of these tasks will result in draft products which can be reviewed by USAARMS and USAICS to evaluate the applicability of the product to their particular situation. Certain feedback obtained from service schools may influence the prototype, while other feedback will be considered in the TRADOC-wide implementation of CAPS.

In reviewing these reports, schools should be aware that report formats are not an issue because the formats of the various reports are largely specified within DoD and DA regulations. These formats were developed to ensure that the information contained in the reports can be easily interpreted by individuals who are not computer professionals. The documents which define the format of these reports are as follows:

- DoD Standard 7935
- Army Technical Bulletin 18-103
- Army Technical Bulletin 18-111
- DoD 5000.12-M, and
- Army Regulation 18-12

The eight tasks to be accomplished during the development of a CAPS are described below. Each description provides an explanation of the task objective and a discussion of the roles of the various participants in reviewing task products. These discussions attempt to define the types of issues addressed in regard to each task product. Appendix A provides a brief summary of the development process.

It is important to consider that the CAPS prototype development tasks are not necessarily listed in the exact chronological sequence in which they will be performed. The task sequence will not be finalized until a contract has been awarded for the development of a working CAPS.

A. Refine/Finalize CAPS Functional Requirements

CAPS functional requirements were defined during the previous concept study to an extent which allowed development of a CAPS design concept and identification of hardware/software requirements for a prototype. Prior to designing a CAPS database (deciding what information to include in a CAPS database and how to arrange this information into tables), it is necessary to check the current accuracy of the functional requirements and to specify certain functional requirements in greater detail.

Before describing specific types of functional requirement issues likely to arise during the performance of this task it is important to consider that the FEA and AMTP/Drill development processes (to be assisted by CAPS) are under development. Based upon lessons learned during the development of prototype AMTP/Drill products by service schools, efforts are being made to incorporate a certain degree of "how to" guidance into TRADOC Reg 310-2 (Test-Revised) and TRADOC Reg 350-7. Similarly, guidance for conducting a FEA

(TRADOC PAM 310-8) is currently under revision. Consideration of new guidance documents will undoubtedly influence CAPS functional requirements. In addition, the potential for applying computer technology to the AMTP/Drill development process may in itself make it advisable to modify the AMTP/Drill development process. For example, modification of the sequence in which certain ARTEP development tasks are performed may be necessary to capitalize on the potential benefits of automation.

Due to the experimental nature of the AMTP/Drill preparation process, draft CAPS functional requirements will be prepared for review by service schools. Draft functional requirements will be developed by ATB, ARI and the contractor. These requirements will reflect consideration of (1) guidance documents for conducting a FEA and preparing AMTP/Drill documents and (2) the ARTEP development process within USAIS.

In their review of the draft functional requirements document, all participants will be asked to answer two broad questions. First, are there ARTEP development jobs which are not addressed (or not adequately addressed) by the draft functional requirements? Second, do the functional requirements appear to address problems encountered in preparing prototype AMTP and Drill documents (e.g., selecting "mission-oriented" chunks of battle to be addressed by STXs)?

Schools will also be asked to respond to more specific questions about the functional requirements as illustrated below.

- o To what level of detail should references to tactical doctrine be recorded in the database (e.g., FM and chapter number or FM and page number or FM, page and paragraph number)?
- o What types of FEA source materials need to be contained in the CAPS database? For example, many schools survey units regarding the "criticality" of missions and tasks. Based upon estimates of the utility of past surveys, schools may or may not want to include the results of such surveys in the database.

The results of reviews by USAARMS and USAICS will be used in one of two ways. The results may influence the functional requirements of the working CAPS (i.e., feedback from USAARMS and USAICS might include innovative ideas for improving the effectiveness/efficiency of the AMTP/Drill development process), or they may serve to document functional requirements which need to be addressed during TRADOC-wide CAPS implementation. The decision about whether to incorporate the feedback into the working CAPS will be made by ATB, ARI and USAIS.

It is expected that, in most cases, modifying the CAPS to accommodate the requirements of a particular school will merely involve expanding the database to include additional tables. However, in cases where a simple expansion of the database is not sufficient to accommodate the needs of particular schools, it is critical that this fact be documented for use by ATSC-IMO as soon as possible.

B. Prepare Organization, Management and Operating Procedures for a CAPS

Three documents will be prepared by the contractor which combine to define the roles and responsibilities of all CAPS managers, supervisors, users, operators and maintainers. Some of the questions to be addressed by these documents are listed below.

- o How will table "owners" (individuals with the authority to create and change the content of specific tables) be designated?
- o How will information be protected from accidental loss?
- o What will be the specific job responsibilities of school computer personnel?

These procedural manuals will be developed by considering CAPS functional requirements, characteristics of CAPS hardware/software, and the manner in which USAIS is task organized to accomplish the ARTEP development process. Therefore, it will be necessary for the contractor to study the current ARTEP development process within USAIS to define specific ARTEP development jobs in terms of inputs, outputs and responsible parties.

It is expected that USAIS and USAARMS will have considerable experience to draw upon in reviewing these documents. Schools on TRADOC installations already have a VAX 11/750 computer as part of the Army Instructional Management System (AIMS), and these schools are currently receiving the INGRES RDBMS for use on the AIMS computer. Thus school computer personnel should have considerable experience with the INGRES and VAX 11/750 prior to receiving the CAPS documents.

Perhaps the key concern of ARTEP developers in reviewing these documents will be to decide if the procedures are compatible with the way their school is task organized to accomplish the ARTEP development process. In addition, schools will want to determine how well these procedures seem to fit work schedules (e.g., must school computer personnel be on hand if it becomes necessary for ARTEP developers to work late at night to meet a short term suspense date?).

Two types of feedback might be expected from schools at this point. First, schools may report inconsistencies between CAPS procedures and school procedures. Inconsistencies which apply to USAIS will be immediately addressed by CAPS developers. Inconsistencies which apply to USAARMS and/or USAICS will be documented for the attention of ATSC-IMO. Second, schools may raise questions about procedures which are inadequately described in the draft CAPS plans and require the immediate attention CAPS developers.

C. Design CAPS Database

The task of designing a CAPS database will be performed by the contractor. The objective of this task is to decide what types of information are to be contained within each table and table column of a CAPS database. The database must be designed to address the CAPS functional requirements identified in the first task of prototype development. For example, if the functional requirements specify that the system should allow users to quickly

identify the specific paragraphs from FMs which apply to a particular STX, then such information must be addressed by database designs.

Designing a CAPS database is an especially critical step in CAPS development. If the database is effectively designed, then it should be relatively easy to apply a RDBMS to ARTEP developments. That is, very simple commands could be used to select and reorganize information in the database. If the database is not well designed, then very complex, lengthy commands may be required to gain information from the database or certain information in the database may be virtually inaccessible to database users. In this case it may be necessary to develop software to guide CAPS users in applying a RDBMS to ARTEP development. Such software development would be costly, and it might reduce the flexibility of a CAPS to accommodate differences among schools.

The job of designing a database for a CAPS prototype is relatively complex and requires considerable experience in RDBMS database design (i.e., particularly in regard to using a RDBMS to support document preparation). Much of the information to be included in a CAPS database is in the form of lists and text. Deciding how to incorporate these types of information in a RDBMS requires either directly relevant experience or experimentation with innovative applications of a RDBMS. Once these problems have been addressed in prototype development (e.g., incorporating text from FMs into the database), the solutions can also be applied to similar problems in future expansions of the CAPS database (e.g., including additional types of text in the database).

The report produced during this task will provide schools with their first detailed view of the contents and organization of a CAPS database. Combined with information about how to select and reorganize information in the database to meet various information needs (to be prepared in the subsequent CAPS development task), it will also provide a detailed picture of how a RDBMS can support specific ARTEP development jobs.

D. Implement Database Design

This task will be performed by the contractor, and it will be performed concurrently with the previous task. The objective of this task is to write standardized INGRES command statements for (1) loading CAPS tables, (2) changing/updating CAPS tables and (3) retrieving information from CAPS tables. These command statements, combined with the description of the contents and organization of a CAPS database provide a detailed view of how a RDBMS can address specific jobs in ARTEP development.

The standardized command statements will be developed, to a large extent, as a database is being designed. One of the goals of database design is to organize information into tables in a way which allows information to be quickly retrieved in a manner which meets the functional requirements of the system. In designing the database, the designer must therefore consider information retrieval. That is, the database must be designed in a way which allows short, simple commands to be used.

Examples of what certain types of INGRES command statements might look like are provided and briefly explained below.

- o create coltask (task = C50, fm refs C255, STX = C100)

This command creates the table previously shown in Figure 4. The command tells the system to create a table called "coltask" and to label the columns "task", "fmrefs" and "stx". In addition, the command indicates the maximum amount of space allocated for each row of each of the three columns (e.g., the title of a collective task can be up to fifty characters in length, and up to 255 characters can be used to list all of the tactical references which apply to a particular collective task).

- o retrieve (c.ctname) where c.fmrefs = "* FM7-10 pg 36 par 4 *"

This command tells the system to list the names of all collective tasks for which paragraph 4 or page 36 of FM 7-10 is a doctrinal reference. (With the exception of the specific doctrinal reference, this command is applicable to any attempt to identify collective tasks supported by a particular doctrine reference . . . within any Army school...given the table design in Figure 4.)

The report covering this task will indicate the CAPS functional specification addressed by each of the standardized commands, and it will also provide a critique of the overall ability of the database design and standardized commands to meet CAPS functional requirements. It is important to note that the functional requirements considered will be those for the working CAPS at USAIS. If time and resources permit, database additions and commands necessary to address functional requirements unique to USAARMS and USAICS will also be assessed. The results of these assessments would be provided to ATSC-IMO.

At the end of this task, a decision will be made about whether the CAPS database appears to be "user friendly" (i.e., can be applied to the ARTEP development process using short, simple commands). This decision will be based on the review of the sample commands contained in the report. The results of this decision will have a profound effect on the work required to perform the subsequent task.

E. Develop Training Plans

The CAPS contractor will be primarily responsible for developing training plans. The amount of work required to develop these plans depends, to a large extent, on the degree to which the CAPS database is "user friendly." If the database is exceptionally "user friendly," then much of the guidance for applying a RDBMS to ARTEP development will be taken from existing INGRES RDBMS user manuals. If the database is moderately "user friendly," then the contractor will probably find it necessary to include standardized commands in the training plan. In addition, the amount of training required to gain an adequate level of proficiency in using INGRES RDBMS may increase. If the CAPS database is not "user friendly," then software may need to be developed to control the application of a RDBMS to ARTEP development.

The work required to develop training plans will also effect what participants in the CAPS project will be asked or required to do when reviewing the draft plans for clarity and adequacy. At present, it is

expected that the CAPS database will be either exceptionally or moderately "user friendly." This expectation is based upon the simple fact that all, or nearly all, of the information within a CAPS database has a relationship to the same variable (i.e., the titles of collective tasks). Briefly, this pervasive relationship is expected to reduce the number of tables one must deal with in attempting to meet a particular information need and thus keep the database commands at a simple level. Perhaps the greatest threat to the simplicity of the CAPS database design is the need to link training requirements at one echelon with those at another echelon.

Much of the CAPS training is intended to be embedded in the system. For example, the standardized commands to be developed in the preceding CAPS development task might be included in a RDBMS table and linked to specific ARTEP development job tasks. The first column of the table might list job tasks (e.g., identifying collective tasks supported by a specific doctrinal reference), the second column might provide the standardized command for reorganizing the database to obtain the information needed to perform the task, a third column might provide "decision aids" where required. In effect, the listing of ARTEP development job tasks in the first column of such a table serves as menu of ARTEP preparation guidance.

According to DoD Standard 7935 and supplementary Army Technical Bulletin 18-111, three types of manuals must also be developed to support the use of an automated system as described below.

- o A "User's Manual" will provide information for the user of a CAPS work station.
- o A "Computer Operational Manual" will provide information for the manager of the system and the manager of the database to use in day-to-day operations.
- o A "Program Maintenance Manual" will provide information regarding future system maintenance.

Schools will be asked to review these manuals and comment upon their clarity and adequacy. These manuals will then be revised by the contractor, as necessary, in preparation for the test of the working CAPS within USAIS.

The Program Maintenance Manual might be of special interest to USAARMS and USAICS, because one key aspect of future maintenance of a CAPS involves expanding the database to serve new functions (i.e., including the USAARMS and USAICS unique functions identified in the first CAPS development task). At present it is expected that the functions to be added to the core system can be anticipated, and effective guidance for applying functions or "types" of functions can be inserted in this manual.

F. Prepare a Cost-Effectiveness Evaluation Plan

ARI will have the primary responsibility for preparing a cost-effective evaluation plan. This plan will be developed to address, at a minimum, the objectives which follow:

- o Assess the extent to which the working CAPS meets the functional requirements identified for USAIS.
- o Ascribe failures to meet functional requirements to specific hardware, software, management/operations plan and/or training plan components of the CAPS.
- o Provide cost data for implementing/maintaining the CAPS and for modifying the CAPS to better address functional requirements.

The evaluation plan is intended to be applied during an extended period of CAPS use. This period of use will begin with user training on the system and continue through the preparation of an entire AMTP document. By using an extended testing period it is hoped that the system will be employed under situations which adequately reflect the variety of workloads found in the typical Army School. That is, the system will be evaluated under realistic conditions.

A draft cost-effectiveness evaluation plan will be staffed for school review, and an In Process Review (IPR) will be conducted to discuss and refine the draft. It is expected that the draft plan may have certain gaps which require input from potential CAPS users. For example, potential system users might anticipate certain problems (based upon their familiarity with the environment in which the system is to be used), and it is necessary to make sure that the evaluation plan is sensitive to these problems.

G. Load Database and Conduct Preliminary Testing

This task will be performed by the contractor at the contractor's facility. The goal of this task is to make any necessary "fixes" in the working CAPS prior to moving the system to USAIS. To accomplish this task, the contractor will load the database with the user POI and FEA source materials (provided by USAIS). The contractor will then conduct limited testing of all hardware and software components of the system, and the contractor will prepare a demonstration of the CAPS for project participants.

H. Install System within USAIS and Evaluate During Operational Use

During this phase the cost-effectiveness evaluation plan will be executed by ARI, ATB and the contractor. This phase begins with the installation of the working CAPS within USAIS, and it continues through the development of a complete AMTP document by USAIS.

It is important to consider that the goal of this task is to refine the CAPS design concept rather than to merely test this concept. On the spot "fixes" will be made by the contractor and tested where necessary and where feasible (as determined by ARI and ATB). The outcome of this task will be a report which:

- o provides the results of the test of the ability of the working CAPS to meet USAIS function requirements,
- o describes and explains the need for any changes made in the working CAPS during the preliminary or formal test period,

- o provides the results of testing any modifications made during the test period,
- o describes and explains the need for changes in the system which could not be made in the course of the test period.

Long-Term CAPS Refinements

Future refinements in the CAPS are facilitated by (1) employing a CAPS design concept which is modular in nature and (2) ensuring compatability with other Army automated systems currently under development. The modular nature of the CAPS concept makes it possible to modify, delete or add modules to reflect the needs of individual schools and/or future changes in ARTEP design. Compatibility with other automated systems ensures that a CAPS can support these other systems, and it ensures these other systems can effectively support the ARTEP development process.

A. Evolution of CAPS as an Expert System

Perhaps Artificial Intelligence (AI) or "expert systems" represent the current pinnacle of computer technology. In essence, these systems mimic the decision processes of experts within a particular field. For example, a CAPS would be considered to be an expert system to the extent that it mimics the thought processes of someone who has finely mastered the complexities of ARTEP development.

To an extent, the CAPS is intended to be an expert system which gets "smarter" through use. For example, CAPS will initially contain "rules of thumb" and standard examples for writing objective performance standards, and these standardized examples will likely be in terms of infantry units. A particular school, such as the Armor School, would have the option and capability to replace the examples in the existing CAPS database with examples tailored in terms of armor. As a result, the CAPS within USAARMS would do a better job of mimicking an expert at developing ARTEP documents for armor units.

The tremendous potential for increasing the level of expertise of a CAPS might also be illustrated by expanding the previous example. The case may be that the initial "rules of thumb" for writing objective standards leave much to be desired. Through the TCMIS which links the CAPS across schools (i.e., to allow sharing of databases), one school might review the databases within other schools to determine whether any other school had successfully improved upon the "rules of thumb" for writing standards. If so, the first school might replace the existing ones with the improved version within its own CAPS database. In this way, an improvement made in the help guidance for preparing ARTEP documents at one school increases the extent to which the CAPS at another school functions as an expert system. This example illustrates both (1) how the CAPS can get smarter and, (2) the importance of ensuring compatibility between CAPS and the TCMIS-Training Module.

An important point concerning the prototype CAPS is that certain decision aids contained in the database may merely serve as a placeholder for improved information developed in the future. That is, decisions which need to be addressed by aids, have been identified, and draft decision aids, regardless of their effectiveness, can serve as tools in designing a CAPS database.

B. Interface with Other Systems Relevant to ARTEP Development.

The CAPS database can expand to incorporate ARTEP-relevant information from other systems currently under development, as illustrated in Figure 6.

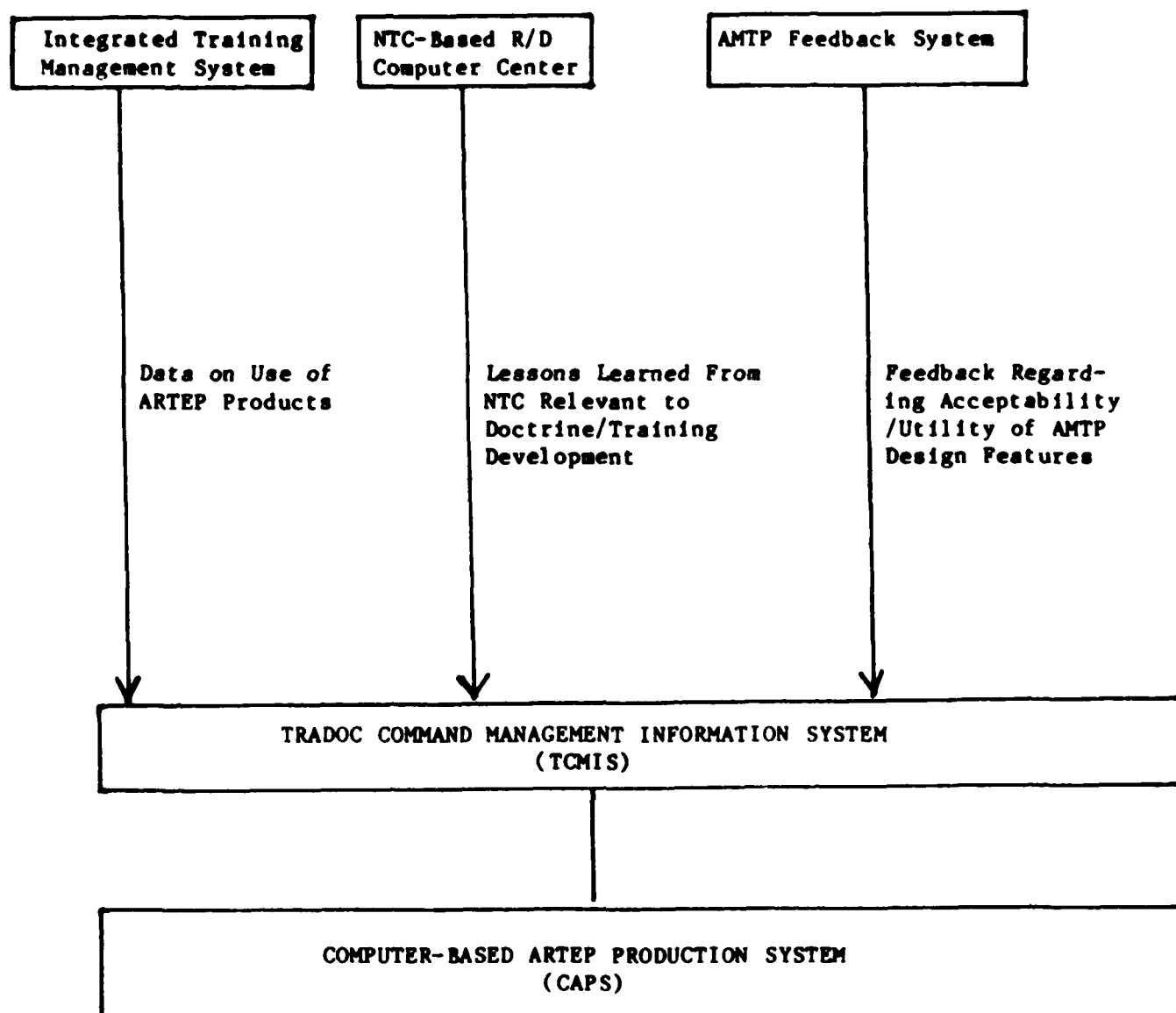


Figure 6. Examples of input for a CAPS database which might be provided through a TRADOC Command Management Information System

These systems, which also employ the INGRES RDBMS, are briefly described below.

- o An Integrated Training Management System (ITMS) is under development by the Army Development Employment Agency (ADEA), ATB, the Combined Arms Center, and ARI. This system is intended to support unit training management for all units within a division through decentralized work stations. Important data from such a system, from the perspective of ARTEP developers, would include the frequency with which specific missions, collective tasks, Drills and STXs are trained. In addition, an Electronic Clipboard under development by ARI and ATB provides input for the ITMS which is relevant to ARTEP development. T&EOs are loaded into the Clipboard from the ITMS, and the results of the application of T&EO standards are input for the ITMS at the end of training/evaluation. Information from the Clipboard/ITMS important to ARTEP developers would include the identification of standards with a high frequency of "not observed" (i.e., suggesting that these standards may require revision).
- o A National Training Center (NTC)-Based Research/Development Computer Center is under development within the ARI Presidio of Monterey Field Unit. Analysis of the data within this system is intended to provide lessons learned from the NTC with potential applications for school doctrine development and training development.
- o An AMTP Feedback System is under development by ATB and ARI in cooperation with the Army's school and integrating centers. The purpose of this system is to gain feedback from units regarding AMTP design features through a series of iterative surveys. Such surveys might find, for example, that a certain AMTP design feature is unacceptable to a particular user population (e.g., Reserve Component of a particular type of unit). In the long-term, it is expected that each school will analyze their own feedback data using their CAPS RDBMS. In the near term, ARI/ATB will analyze the feedback data using INGRES and forward significant findings to appropriate integrating centers and schools.

APPENDIX A

MANAGEMENT SUMMARY OF CAPS DEVELOPMENT

Given the need for prompt, effective application of computer technology to ARTEP development, it is important that the review process for all CAPS contractor products be carefully orchestrated to avoid delays. Input for revisions of draft reports/manuals is to be provided to the contractor within 15 days of the delivery of the draft product. Therefore, these rapid response reviews must be carefully defined in terms of (1) project participants taking part in these reviews and (2) major areas of concern of each participant.

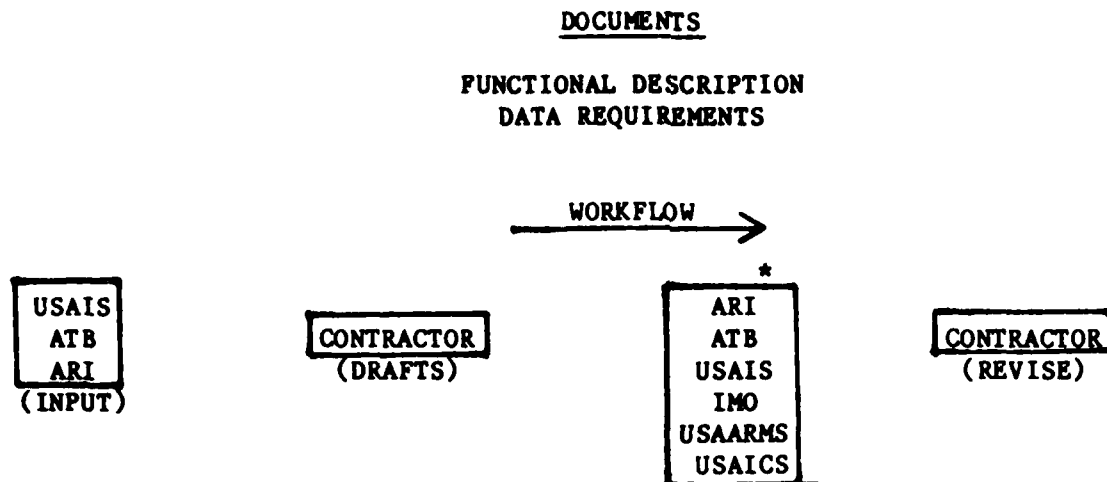
The purpose of this Appendix is to provide information which each of the various points of contact (POCs) can use to manage their organizations involvement in each task of developing a working CAPS. This information will be supplemented with a contract performance plan containing project milestones, after the CAPS contract is awarded.

The following pages contain the types of management information described below for each task in CAPS development.

- o draft reports/manuals to be reviewed
- o specification of the organizations asked to review each draft document prior to contractor revision
- o brief description of the primary concerns of each organization in conducting their review

Most of the documents to be produced are defined by AR 25-5 and a series of Technical Bulletins/Standards. ARI is responsible for making sure that documents are in compliance with these requirements. It is also expected that ATSC-IMO will also be interested in the compliance of these documents with automation requirements, because of the importance of ensuring compatibility between the CAPS and other components of the TCMIS-Training Module.

TASK 1: REFINE/FINALIZE CAPS FUNCTIONAL REQUIREMENTS



INTERESTS

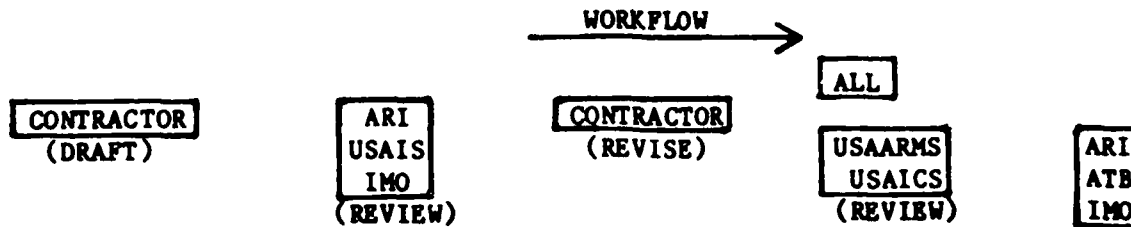
- o USAIS/ATB/ARI: The process to which computer technology is to be applied (AMTP/Drill preparation) is itself under development. There is a need to (1) consider how to best refine the process before applying automation and (2) make sure the functional requirements fit the refined process.
- o ATSC-IMO: IMO is concerned with effectively linking the CAPS to other components of the TCMIS-Training Module. IMO's interests include such topics as (1) desired (possibly long-term) functions which are contingent on linking the CAPS with other training module components and (2) differences in CAPS functional requirements among schools.
- o USAARMS/USAICS: These schools are concerned with identifying (1) functional requirements for the working CAPS which would be inappropriate for their schools and (2) functional requirements they would want to add if the working CAPS were being developed within their schools. (NOTE: This feedback does not need to be provided in time for contractor revision).

*An IPR will be conducted and all project participants will be invited and asked to provide feedback.

TASK 2: PREPARE ORGANIZATION, MANAGEMENT AND OPERATING PROCEDURES

DOCUMENTS

- o **SYSTEMS/SUBSYSTEM SPECIFICATIONS**
- o **PROGRAM SPECIFICATIONS**



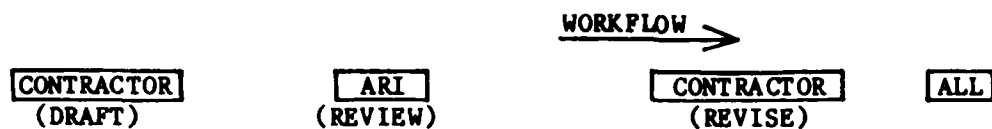
INTERESTS

- o **ARI/USAIS** Make sure CAPS procedures are thoroughly described and are compatible with USAIS procedures.
- o **IMO** Make sure specifications support compatibility between CAPS and other components of the Training Module.
- o **USAARMS/USAICS** Identify procedures inappropriate for application in their schools.

TASK 3: DESIGN DATABASE / TASK 4: IMPLEMENT DATABASE DESIGN

DOCUMENTS

DATABASE SPECIFICATION



INTERESTS

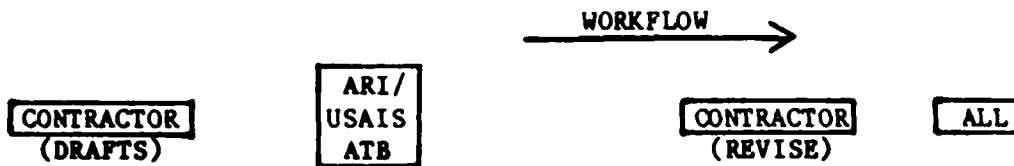
ARI/USAIS: Decide which functional requirements are/are not addressed by database design.

ALL: Estimates of the extent to which the database design is "user friendly."

TASK 5: DEVELOP TRAINING PLANS

DOCUMENTS

- o USER'S MANUAL
- o COMPUTER OPERATION MANUAL
- o PROGRAM MAINTENANCE MANUAL
- o TRAINING COURSE/CURRICULUM OUTLINES



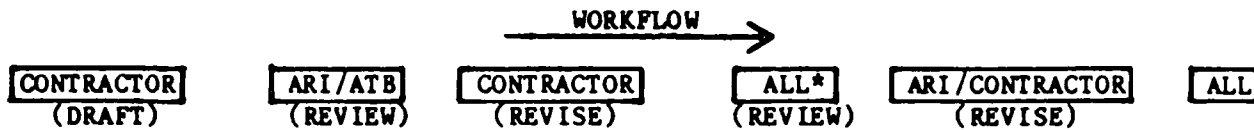
INTERESTS

- o ARI-USAIS/ATB: Reviews of training plans and manuals will be conducted to make sure that these materials appear to be complete and clearly written. The key goal of this review is to record (1) questions the reviewers have before reading the materials which are not effectively addressed by these documents and (2) questions raised during the review of these documents.

TASK 6: PREPARE A COST-EFFECTIVENESS EVALUATION PLAN

DOCUMENT

SYSTEM/COST-EFFECTIVENESS PROGRAM PLAN



INTERESTS

- o ARI/ATB: Making sure that the plan (1) effectively addresses all CAPS functional requirements and (2) can be supported by available ARI, ATB and contractor personnel.

- o USAIS: Making sure that the plan (1) imposes reasonable requirements on USAIS and (2) is sensitive to the USAIS working environment.

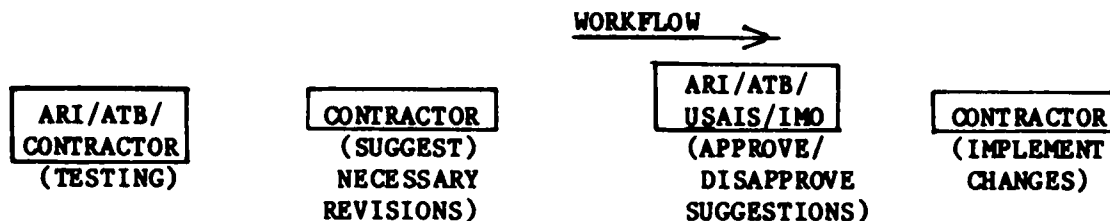
- o USAARMS/USAICS: Making sure that the plan is sensitive to school working environments.

*IPR

TASK 7: LOAD DATABASE AND CONDUCT PRELIMINARY TESTING

DOCUMENTS

PREVIOUSLY PREPARED DOCUMENTS MAY BE REVISED
AS A RESULT OF PRELIMINARY TESTING BY ARI, ATB
AND THE CONTRACTOR AT THE CONTRACTOR'S FACILITY.



INTERESTS

- o ARI/ATB: Test the ability of the working CAPS to meet those functional requirements which can meaningfully be tested outside a school context. Approve/disapprove suggestions for system "fixes" depending upon "feasibility."
- o ASTC-IMO: Concerned with making sure that suggested changes in hardware/software do not reduce compatibility between CAPS and other components.
- o USAIS: Concerned with making sure that system "fixes" are compatible with USAIS procedures.

TASK 8: INSTALL SYSTEM WITHIN USAIS AND EVALUATE DURING OPERATIONAL USE

DOCUMENTS

- o PREVIOUSLY PREPARED DOCUMENTS MAY BE REVISED IN RESPONSE TO THE FINDINGS OF THE COST-EFFECTIVENESS EVALUATION.
- o FINAL REPORT (INCLUDING RESULTS OF EVALUATION)

WORKFLOW ➔

TESTING



FINAL REPORT/DOCUMENT REVISION



INTERESTS

- o ARI/ATB: Approving/disapproving changes based on "feasibility." Data collection and analysis.
- o USAIS: Using system and providing feedback regarding"
 - overall usefulness
 - ease of use
 - specific problems in application